In this manuscript, the authors investigated post-fire thaw depth within one fire event in the Republic of Sakha. They used a combination of field data collected one year post-burn and compare this field data with multiple remote sensing indices derived from Landsat optical and thermal data. The environmental characteristics assessed included a variety of vegetation, fire severity, and thaw depth characteristics. The remote sensing techniques included several pre- and post-fire indices, including land surface temperature. Through their field work, the authors found deeper thaw in burned areas and well-drained areas. The authors found that the remote sensing characteristics assessed explained 66.3% of the variability in the field-measured thaw depth. Additionally, it was found that land surface temperature correlated highly with post-fire thaw depth (42.9% of the variability explained).

This was a well-written manuscript which clearly described the research planned and conducted, both in the field, and with the remote sensing techniques. The use of Landsat thermal data to assess thaw depth was a new application, and it was surprising that the correlation was so high, especially considering that the resolution of the data was 100m. The discussion section mentioned some of the concerns with these new techniques and adequately addressed them, including the resolution of the Landsat thermal data, the small sample size of the field dataset, and the timing of the collection of the field data (mid-summer, as opposed to end of summer when active layer thickness could be collected). The authors also provided a worthwhile discussion of future research including the use of more advanced machine learning techniques, collecting additional field data, and incorporating radar data into such an analysis in the future.

We thank the reviewer for the constructive and valuable assessment of our paper. A point-by-point response is provided below. The original reviewer comments are in **bold**, *author comments in italic, and manuscript amendments are given in* green.

Comments:

1. **Line 22 and 232 – Was the thaw depth significantly deeper in burned than unburned plots? The mean and standard deviation are provided, but the significance level is not. Please provide it if possible.**

Thank you for the comment. We will address this in the revised version of the manuscript:

On average, summer thaw was deeper in burned (mean = 127.3 cm, standard deviation (sd) = 27.7 cm) than in unburned (98.1 cm, sd = 26.9 cm) plots (Fig. 2). An independent t-test indicated that this difference is statistically significant (p = 0.04).

2. **Section 2.3 – Consider a table to show the indices used and the formulas, as a way for readers to have a quick overview. Perhaps this could go in the Appendix.**

Thank you for your suggestion. We will add a table to the Appendix as suggested (Table R1).

3. **Line 160-162 – The pre-fire imagery is from 2 years prior to the fire, and 2 scenes needed to be mosaicked together to cover the entire fire event – Could this have affected any of the results? Consider adding a clarifying statement in either the methods or discussion section.**

We understand the reviewer's concern. However, we do not expect that using a pre-fire image from two years before the fire event significantly impacted our results, because it was representative of the environmental conditions before the fire, since no other disturbance occurred in the area between two years and one year before the fire. This is in line with recommendations from Key and Benson (2006) who stated that the acquisition of pre-fire imagery can safely be from two to three years before the fire, as long as other landscape disturbances do not interfere with the subject burn. We will add a statement to the methods as suggested:

For the pre-fire imagery, we used a cloud-free image from July 7, 2016, near the anniversary date of the post-fire imagery. No cloud-free summer images were available from 2017. This timing aligns with recommendations from Key and Benson (2006), since no other disturbance had occurred between two years and one year before the fire.

Furthermore, we indeed mosaicked two Landsat scenes to acquire near-full coverage of the fire scar. Both before and after the fire, these two scenes were from the same day. As a result, the mosaicked scenes represent comparable environmental conditions.

4. **Line 289 – The case studies of the 2 burned/unburned plot pairs undoubtedly helped in separating the impact of fire on thaw from topographic and vegetation influences, but this is still a very small sample size, and should be treated as such. Perhaps soften the language here from “enabled”, to show that this small sample size would not fully address all situations in separating influences on thaw depth.**

We will use a softer term as suggested by the review. Please find the proposed new sentence below:

Our case studies of two burned-unburned plot pairs divided by a fire barrier, though limited in sample size, helped us to separate the impact of fire on the active layer thaw from topographic and vegetation influences.

5. **Figure A2 – Figure 2 provides a description of the meaning of the triangle and the bounds of the box plot, but it is not repeated in Figure A2. Consider adding it again here as the Appendix is separate from the main manuscript and readers could be confused.**

Thank you for pointing this out. We will add the description to the figure as suggested. Please see Figure R1.

References

Key, C. H. and Benson, N. C.: Landscape Assessment (LA), in: FIREMON: Fire effects monitoring and inventory system, edited by: Lutes, D. C. ;, Keane, R. E. ;, Caratti, J. F. ;, Key, C. H. ;, Benson, N. C. ;, Sutherland, S., and Gangi, L. J., U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station., Fort Collins, CO, 1–55, 2006.

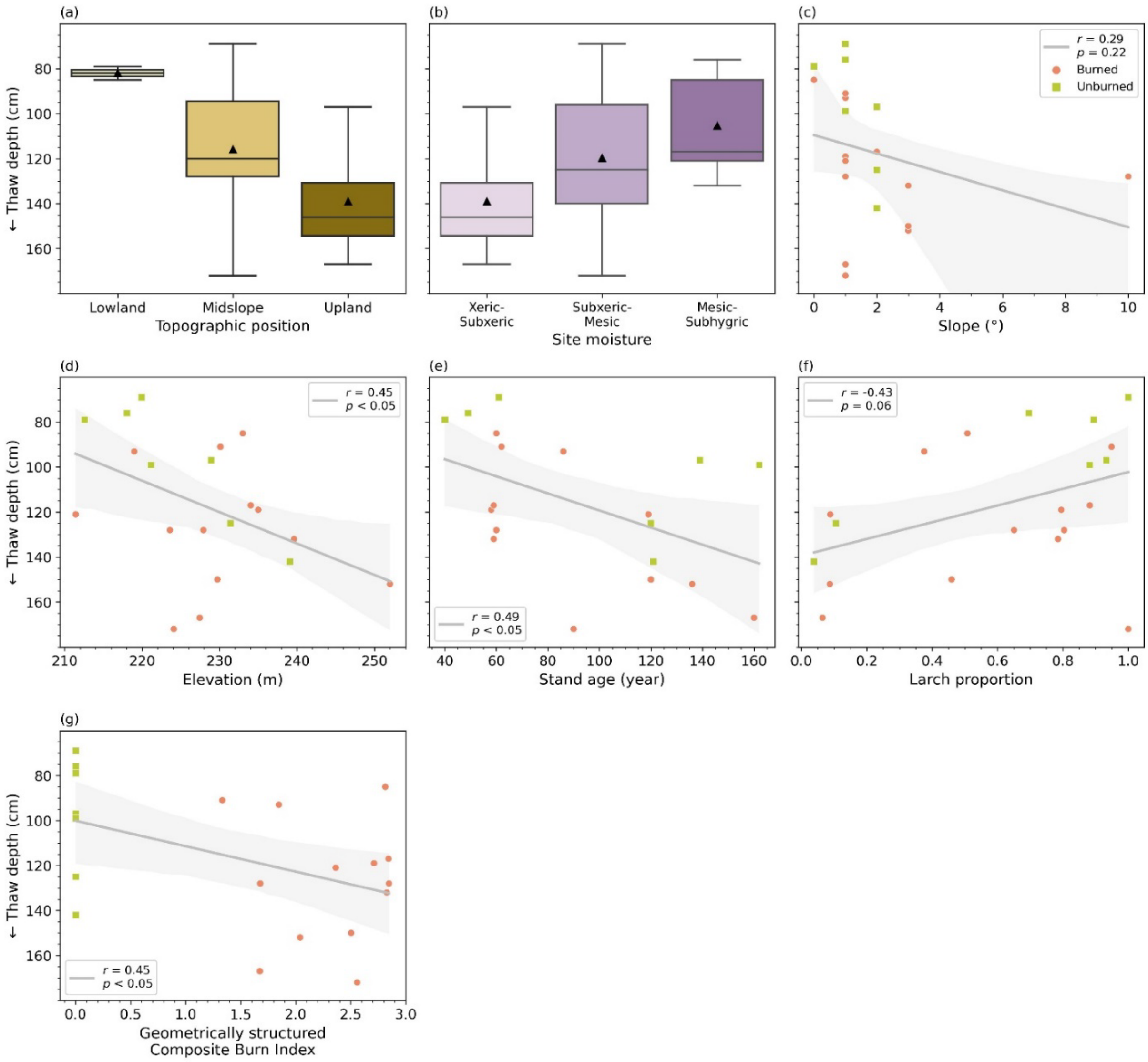

Figure R1: Relationships between (a) topographic position, (b) site moisture, (c) slope, (d) elevation, (e) stand age, (f) larch proportion, (g) Geometrically structured Composite Burn Index, and thaw depth. In (a) and (b), each box ranges from the first to the third quartile. Whiskers extend to points that lie within 1.5 times the interquartile range. The median is indicated by the horizontal line and the mean by the black triangle. For site moisture, classes were grouped together for better visualization.

Table R1: Summary of the remote sensing metrics used in the study. ρ represents the reflectance of the Landsat 8 Operational Land Imager bands. L_λ^{sen} is the Landsat 8 Thermal Infrared Sensor band 10 radiance. K_1 and K_2 are calibration constants. $L_\lambda^{\downarrow}$ and $L_\lambda^{\uparrow}$ are the downwelling and upwelling atmospheric radiances and τ_λ is the atmospheric transmittance.

Remote sensing metric	**Equation**
Normalized Difference Vegetation Index (NDVI)	$NDVI = \frac{\rho_5 - \rho_4}{\rho_5 + \rho_4}$
Albedo ($\boldsymbol{\alpha}$)	$\alpha = 0.356\rho_2 + 0.130\rho_4 + 0.373\rho_5 + 0.085\rho_6 + 0.072\rho_7 - 0.0018$
differenced Normalized Burn Ratio (dNBR)	$dNBR = NBR_{pre-fire} - NBR_{post-fire}$, where $NBR = \frac{\rho_5 - \rho_7}{\rho_5 + \rho_7}$
Fractional vegetation cover ($\boldsymbol{P_V}$)	$P_V = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}\right)^2$, where $NDVI_{min}$ = 0.2 and $NDVI_{max}$ = 0.5
Land surface emissivity ($\boldsymbol{\varepsilon}$)	$\varepsilon = \begin{cases} 0.962 & 0.0 \leq NDVI < 0.2 \\ 0.990P_V + 0.962(1 - P_V) + d\varepsilon & 0.2 \leq NDVI \leq 0.5 \\ 0.990 & NDVI > 0.5 \\ 0.993 & NDVI < 0.0 \end{cases}$ $d\varepsilon = (1 - 0.962)0.990F'(1 - P_V)$, where F' = 0.55

Land surface temperature (LST)	$LST = \dfrac{K_2}{ln\left(\dfrac{K_1}{\dfrac{L_\lambda^{sen} - L_\lambda^{\uparrow} - \tau_\lambda(1-\varepsilon_\lambda)L_\lambda^{\downarrow}}{\tau_\lambda \varepsilon_\lambda}} + 1\right)}$